Proposed NASA-LaRC Support for the CLAMS Experiment

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Two automated sun-tracking solar radiometers are operated at NASA - Langley Research Center (LaRC) on days with significant clear sky periods that allow for direct sun measurements. Measurements by the radiometers will be collected in support of the CLAMS experiment. This will provide supplemental optical depth measurements within the CLAMS measurement region and enable an assessment of the geographic variability in the measured atmospheric attenuation. Additionally, this provides the opportunity to compare our radiometer optical depth retrievals with compatible measurements to assess the quality of our retrievals.

Instrumentation

The radiometers were designed and built at the University of Arizona and have been operated regularly at LaRC since February 2000. The solar radiometers (referred to as LaRC and Sage3) consist of 10 parallel field of view (FOV) telescopes pointed towards the sun via an active auto sun-tracking system with a maximum tracking error of ± 0.5°. Each channel consists of a geometrical aperture defined telescope (2.0° full angle FOV), interference filter and silicone photodiode/op amp combination. The center wavelength and bandpass for each interference filter are listed in Table 1. The Sage3 radiometer has an additional channel at 1552 nm so as to mimic the measurement channels of the Sage III satellite instrument. Each photodiode/op amp module is temperature stabilized to ensure uniform responsivity throughout the course of data collection. The instruments are deployed on a platform in the northeast section of the NASA facilities (37°6’ 18” N, 76° 22’ 44” W) at an altitude nominally above sea level. The radiometers have a clear field of view of the southern portion of the sky and horizon obstructions interfere with measurements at solar zenith angles greater than 80°.

Data

Upon initialization of the system into automatic sun-tracking mode, data from each channel is recorded at 1-minute intervals. Shorter sampling times down to 10-second intervals are available. A series of five consecutive dark count samples are collected at different points throughout the day. The direct sun measurements are used to retrieve the total optical depth at the 21 wavelength channels through Langley analysis. A record of the exoatmospheric signal (V_0) of each channel has been collected and reveals good stability of the interference filter response. During the period that routine measurements are available, most channels have a fractional uncertainty in $V_0 \leq 5\%$. Channel 9 in both radiometers has a larger fractional uncertainty in V_0 (on the order of 10%) due to interference by water vapor absorption at these wavelengths.

The collected data is processed each day at the conclusion of measurements. The average dark count for each channel is subtracted from the direct sun measurements and morning and afternoon Langley plots for each channel are generated. The V_0 and average dark count values are compared with the data record as a check on data quality. The total optical depth for each channel is computed for each sample and a text file and diurnal plot are produced. A simple cloud-screening algorithm is applied to remove the obvious cloud transits from the total optical depth data output. During the CLAMS measurement period, the radiometers will be deployed at LaRC and collect direct sun measurements while clear-sky conditions persist. Processed data will be made available through an ftp site to other members of CLAMS.

Table 1. Center wavelength (λ_c) and filter width at half maximum (FWHM) for the two radiometers.

LaRC Radiometer			**Sage3 Radiometer**		
Channel	λ_c (nm)	FWHM (nm)	Channel	λ_c (nm)	FWHM (nm)
1	341.00	9.67	1	383.0	11.59
2	361.77	9.28	2	401.5	9.83
3	459.42	9.14	3	437.0	11.16
4	578.84	9.13	4	522.5	10.43
5	633.42	10.22	5	610.0	10.28
6	752.16	10.20	6	667.0	11.70
7	768.44	11.50	7	779.5	11.38
8	830.64	8.91	8	871.6	9.61
9	955.16	39.43	9	940.5	7.29
10	1015.60	9.40	10	1032.0	7.82
			11	1552.0	10.50